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NUSC Technical Report 4631

Machine for Information Display And Simulation (MIDAS)

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25 September 1973

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ADMINISTRATIVE INFORMATION

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ABSTRACT

The Machine for Information Display and Simulation (MIDAS) is a tool for basic display research and a simulator for evaluating console design. A Data General Supernova Minicomputer directs the operation of two independent high-resolution display controllers. A Honeywell DDP-516 Minicomputer executes real-time mathematical models of the AN/SQS-26 sonar system and its environment and targets. Control of the wide dynamic range of display parameters (e.g., refresh rate and video and deflection signals) are accessible to the experimenter for display research. The simulation capabilities of MIDAS are demonstrated by its display-level simulation of the AN/SQS-26 MOD Display Subsystem in order to evaluate the subsystem prior to specification. The MIDAS hardware is described with emphasis on that which is special purpose as opposed to commercially available equipment. The discussion of software also emphasizes the special purpose category, which consists of control, display, interaction, modeling, and analytical efforts. A typical sequence for initiating an experiment is described, and current plans and accommodations to expand MIDAS are discussed.

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INTRODUCTION

Increasingly, a greater amount of real-time quantitative and qualitative information is presented to the sonar operator for decision making. In the past, the operator could be trained to deal with simple displays containing limited information, but data can now be imposed at rates exceeding human capacity. If the goal is for each sonar system to process maximum information — not data — a means to optimize the displays and the entire information processing system is required. In order to develop these means, the information transmission barrier between man and machine must be understood.

The same technology that has created the increased information load on the sonar operator can be employed to reduce it. Digital computers and special purpose hardware controlled by the operator can be used to partition and selectively process the data to be analyzed. Questions remain, however, as to how, when, and by what means these ideas are to be implemented. The research tool to answer such questions must be flexible in order to evaluate a variety of data presentation techniques and expandable to accommodate alterations that will be required as a result of the study. For example, the hardware must be capable of presenting active and passive sonar data, each of which has a variety of formats. Also, for each display condition, the experimenter* must be able to control such variable display parameters as the (1) data base (which includes a wide variety of signals), (2) refresh rate, (3) number of intensity levels, (4) number of available formats, and (5) interaction tools and their functions. If a hardware change is found to be desirable as a result of the study, the hardware should be adaptable to reconfiguration without an unreasonable amount of effort.

The support software for a research tool such as MIDAS is a substantial portion of the total system. System flexibility and expandability are possible when the software is capable of interfacing system components. Much of the

*Throughout this report there are references to an experimenter and to a subject. The experimenter creates, controls, and monitors the experimental trials. The subject observes the display and, interacting with the system, attempts to search, track, and classify targets.

system software can be generated in higher level languages, such as ALGOL and FORTRAN. However, no such general purpose display language exists for the display-format generation and its program must be written in assembly language.

A realistic data base is essential to productive research. For sonar display work, the experimenter must be able to control the type and location of the target signal for a particular type of ambient noise. The display researcher has, heretofore, been limited to fixed experimental conditions of actual recorded sea data, but mathematical models can now realistically simulate many actual targets in various noise fields and environmental conditions. The hardware and software efforts and a description of an extensive mathematical model will be discussed in detail later in this report.

The Machine for Information Display and Simulation (MIDAS) was designed by the Naval Underwater Systems Center (NUSC) to explore the information transmission problems between man and machine. The design[1] employed existing, Navy-owned mathematical models by dedicating a general purpose minicomputer identical to the unit (in which the models currently reside) in the AN/SQS-26 Sonar Team Trainer (Device 14E19). Once a realistic input data base was assured, the total system was designed to be flexible and expandable. The first sonar configuration is a simulation of the AN/SQS-26 MOD Sonar Display Subsystem. When this MOD configuration is discussed in some detail later in this report, its adaptability to other sonar display systems will become obvious. The MIDAS hardware used for display research need not resemble or simulate a particular sonar system; much research emphasizes basic, not system oriented, cathode-ray tube (CRT) display formats and subject interaction parameters. Honeywell Marine Systems Division, West Covina, California, first delivered the operational mathematical models for the trainers and was contracted to complete the hardware design and develop the basic software.

The general configuration of MIDAS is a two-channel display system controlled by a Supernova Minicomputer. Each display channel can be independently controlled so that two different sonar formats may be displayed simultaneously. Each channel can display 16 levels of brightness and the basic format is 512 x 512 points at 40 frames per second; the maximum resolution is 2048 points per axis. A DDP-516 Minicomputer generates sonar data that are then formatted for display by a Supernova Minicomputer. The basic format generators are raster, spiral scan, and direct write. An adequate number of peripherals are included in the system.

Among the sonar formats that can be programmed are: DIMUS type, PPI, A-Scan, B-Scan, situation summary displays, and narrowband displays. For either display channel, any sonar format can be held in storage for instant call-up by the subject from the sonar console. For those stored sonar formats requiring data histories, the histories continue to be formed while the format is resident on the disc.

HARDWARE

MIDAS hardware[2] consists of a Data General Supernova Minicomputer and a Honeywell DDP-516 Minicomputer and many of their supported peripherals, two high-resolution CRT monitors, and several interactive control devices. Figure 1 is a block diagram of the hardware system. The long dashed lines in the figure denote physical units and the components within each; the short dashed lines indicate functional grouping. Figure 2 is a photograph of the interface cabinet, which is the major unit.

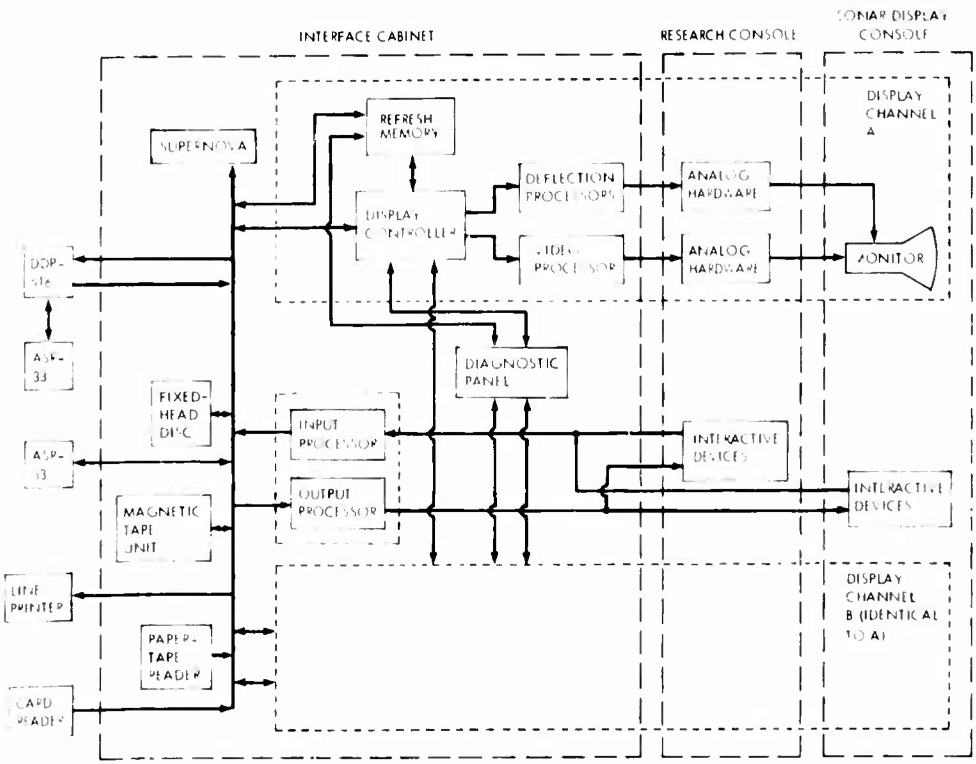

Figure 1. MIDAS Block Diagram

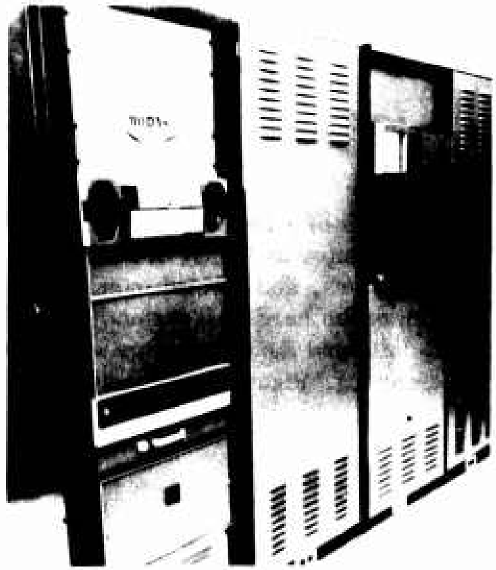

Figure 2. Interface Cabinet

GENERAL PURPOSE HARDWARE

System Controller

MIDAS is controlled by a Supernova Minicomputer configured in maximum (32K 16-bit words) core memory. The Supernova is well suited for this operation because:

a. It has an 800-ns cycle-time core memory and a 600-ns cycle-time semiconductor memory is available for future updating.

b. It has 4 accumulators for programming ease.

c. Its input/output structure is not prewired; thus, the user can design it according to his needs (which, in the case of MIDAS, was for maximum flexibility).

d. A high-speed arithmetic logic and a data channel are available options.

e. A full line of peripherals is supported.

f. The computer and its peripherals are cost effective.

Peripherals

All the peripherals except the teletypewriter connected to the DDP-516 Minicomputer are supported by the Data General Corp. The computer peripherals shown in figure 1 and their characteristics are listed below (the way they are used is discussed later).

- Disc. The fixed-head disc is the fast-access mass-storage device. It has a 256K-word capacity, an average latency time of 8.4 ms, and an average transfer rate of 57,835 words per second.

- Magnetic-Tape Unit. The magnetic-tape unit reads and writes nine tracks at 37.5 inches per second at a bit density of 800 bits per inch.

- Card Reader. The card reader processes standard 12-row, 80-column cards at up to 400 cards per second.

- Line Printer. The line printer produces hard copy in lines 80 columns wide at 356 lines per minute.

- Paper-Tape Reader. The paper-tape reader photoelectrically processes 8-channel-perforated Mylar or paper tape. It is the brakeclutch type and operates at up to 300 lines per second.

- Teletypewriters. The two system teletypewriters are automatic send and receive (ASR-33) units that type, punch, or read at 10 characters per second.

SPECIAL PURPOSE HARDWARE

DDP-516

A Honeywell DDP-516 Minicomputer, in which resides an extensive set of mathematical models of the sonar environment, is treated as a special system peripheral. It is a single-accumulator 960-ns cycle-time machine that is fully configured in 32K 16-bit words of memory. The direct multiplex control (DMC) option was selected to optimize the transfer of data and control between the DDP-516 and the Supernova.

Display Controller

The display controller interprets and excutes Supernova instructions to generate the display signals. Its major function is to drive two independent and simultaneous high-resolution display channels from individual core-refresh memories. Upon receiving format instructions and display data stored within the refresh buffer memory, the display controller activates the appropriate deflection and video processors (see figure 1). The display controller output consists of digital information that is transformed into analog signals for the display monitor's X, Y, and Z terminals. The digital to analog conversion is executed in the research console.

The display refresh buffer memory for each channel stores the actual displayed data and control words. Each buffer memory consists of a megabit of core memory with a cycle time of approximately 1 μs. The refresh memory is 64K 16-bit words to the Supernova; the refresh memory to the display controller appears to contain 16K 64-bit words.

Deflection Processors

Each display channel contains two complete and different deflection processors, one for major and one for minor deflection. Character generation is the only minor deflection function; the major deflection processor performs all other CRT beam motions. Each major deflection processor is partitioned into direct write and raster (plus other nondirect write) segments.

A direct-write controller is a deflection processor that generates random deflection instructions according to the desired output. Alphanumeric, dot, and vector generators output directly to the CRT deflection circuitry. For example, if the display controller needs a dot at position A, the dot generator decodes the instruction, produces the X_A and Y_A deflection voltages, and retains them until the video generator unblanks the beam. The resolution of the direct-write generators is 2048 (11-bit) elements in each X and Y axis.

A raster generator is a deflection processor that produces a well defined set of repetitious deflection signals. The two raster generator types present in MIDAS are the spiral and the rectangular. The spiral raster generator produces a series of concentric circles whose radii increase with time. Deflection transients introduced when a radius is incremented are suppressed from view by blanking the first 24 deg of each circle and are allowed to settle prior to unblanking. Each circle consists of 720 points (i.e., 1/2 deg of resolution). Each point may be intensified with any one of 16 grey levels. The maximum number of circles is 256.

The rectangular raster generator produces X and Y signals to linearly and systematically sweep the beam across and down the tube in a manner similar to a television scan. During the sweep of the beam along the fast axis, which may be orientated horizontally or vertically, the Z-axis signal is "chopped" into 512, 1024, or 2048 discrete steps. At each video bin, or "chop," the beam intensity (one of 16 grey levels) is proportional to the amplitude of the data. The number of lines along the slow axis is a function of the desired format appearance, which may or may not be limited by the amount of data or time available in the refresh interval. Typical sonar raster formats require 288 lines of 512 points with 4-bits intensity refreshed at 40 frames per second. Each display channel easily accommodates such requirements. The maximum output from the raster generator is a 2-megabit display, e.g., at 20 frames per second, 1024 x 1024 x 2 bits, 2048 x 512 x 2 bits, or 2048 x 256 x 4 bits. Contents of both memories are dumped to a single display channel for 2-megabit displays.

Video Processor

The Z axis, or intensity control, in MIDAS is ideal for purposes of display research. The video parameters in the direct-write mode are dim, bright, and blinking, whereas in all raster modes 4 bits (16 grey levels) are provided. The 16 grey levels are routed individually at one point for independent adjustment to any brightness within the dynamic range of the video processor. This means that various intensity scaling relationships (e.g., logarithmic or linear) can be controlled for experimentation — a feature that exists for all raster data.

Additional hardware intensity functions — i.e., those under software control — that are available in MIDAS, are threshold, saturation, video gain, and individual level blanking. Each of these functions is executed after the data leave the refresh buffer memory; thus, the stored data are modified. Only data that exceed the threshold level are displayed. Data in excess of saturation are displayed at the saturation level and those that are between saturation and threshold are amplified (by adjusting video gain) to take advantage of the dynamic range of the CRT's intensity. Each of the 16 grey levels can be independently disabled via software instructions. Display degradation studies are one example of the need for such features.

Diagnostic Panel

This hardware feature was incorporated in MIDAS for convenience when performing system tests. The panel permits one or both of the display channels to be tested from the display controller to the CRT (see figure 1). The diagnostic panel makes it possible to enter any display instruction and all display data without assistance from the Supernova. A 16-bit light-emitting diode (LED) register permits display of any display controller storage register or display memory location. Since the diagnostic panel permits one channel to be independent of the computers, a technician can troubleshoot that channel while a programmer debugs software on the other.

Research Console

The research console is strictly a research tool and does not resemble a sonar operator's console. It combines the largest CRT with the smallest spot size and maximum resolution in direct-write and raster modes to facilitate investigation of the total scope of current and future display needs. It is configured to physically contain and electrically drive a 21-in.-diameter, or larger, CRT monitor. Although the large CRT monitor was not procured with the system, the necessary high-speed, high-resolution digital and analog circuitry was designed for it. In theory, the speed and accuracy of the display controller will meet or exceed the specifications for the large monitor.

Equipment housed in the research console (figure 3) consists of interaction tools: light pen, track ball, a 63-key keyboard, and 12 back-lighted function keys. The research console is designed in such a way that other interactive devices (e.g., data tablets or storage-type CRTs) can be added in the future. Eventually all such devices will be evaluated for possible use in sonar consoles.

Sonar Display Console

The appearance and "feel" of display console controls are important if the simulation is to be realistic. Currently, the console (figure 4) resembles the proposed AN/SQS-26 MOD display console, which is to be evaluated prior to specification for Fleet use. The MIDAS sonar display console can easily be modified to physically resemble other sonar display consoles; a different set of switches (or switch positions) may be all that is required to change configurations. Of course, new software would be necessary.

The MIDAS sonar display console consists of a single electronics bay in which two CRT monitors and interaction devices are installed. Each monitor has a 12-in.-rectangular tube coated with P40 phosphor. The useful viewing area is 7 x 9 in. and the long side is horizontal. Because the driving circuitry for one channel was designed for the research console, the resolution of the monitors is 2048 x 2048 addressable points. The requirement for two independent display channels originated with the AN/SQS-26 MOD Program. It was more economical to duplicate the second channel using high-resolution hardware than to design lower resolution hardware.

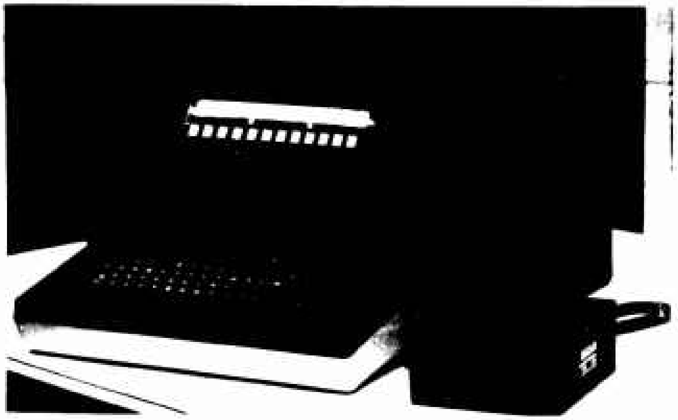

Figure 3. Research Console Interactive Devices

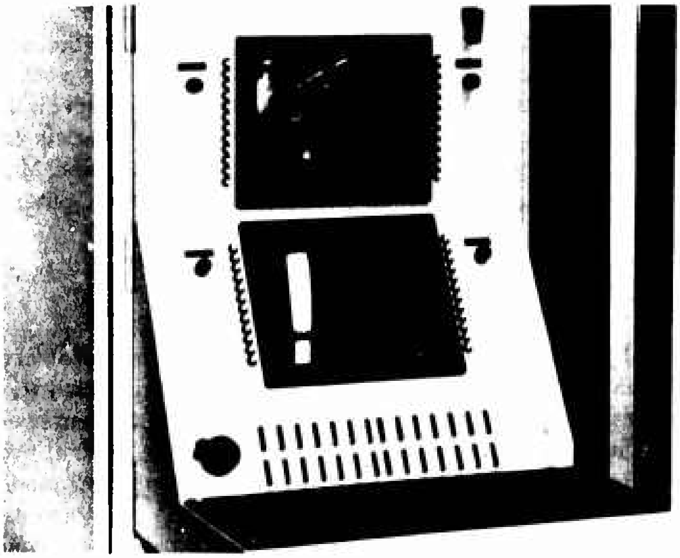

Figure 4. Sonar Display Console

The array of interaction devices at the sonar display console consists of 72 function keys, a force joystick, and a single-axis cursor manipulator. Twelve nonlegend, back-lighted, display-specific function switches are arranged vertically on each side of each CRT for a total of 48. The legend for each back-lighted switch is written on the CRT adjacent to the switch (see figure 4). The figure also shows the set of 24 single-legend, back-lighted, experiment-specific function keys arranged in two horizontally adjacent clusters of two rows of six switches below the bottom CRT.

SOFTWARE

The software effort necessary to employ the system in the desired mode is often underestimated. Whether the programming effort is to efficiently use the system resources or to make a particular experiment easier to program, it is real and substantial. The general and special purpose software applicable to the display simulator will be discussed below to provide insight into the simulator programming effort.

GENERAL PURPOSE SOFTWARE

All computer manufacturers publish manuals that describe the operation and programming of their equipment. Also, specific software packages, which make the computers useful to persons who are not computer specialists, are typically delivered with a machine. Such software usually consists of assemblers, editors, monitors, debugging routines and, possibly, compilers. Manufacturers' manuals and an entire set of this type of software for each computer were delivered with MIDAS.

SPECIAL PURPOSE SOFTWARE

The special purpose software required to use the simulator are in the five categories[3] of control, display, interaction, mathematical modeling, and analytic software. The first three programs mentioned above are system specific because they are dependent upon the hardware configuration of the central processor units (CPUs), peripherals, and interaction tools. Mathematical models produce the input data base and the analytic software reduces the response data base. The initial set of specialized software delivered with the hardware is described below. Maintenance and extension of this software will be the responsibility of the NUSC Displays Branch.

Control Software

The specialized control software is in total command of the system in both offline and online situations. The executive program is the control software for the offline, or initialization, phase. It controls the location and operation of peripherals and general purpose software. Thus, if the programmer wants to use the debugging routine, it is the executive that copies the debugging routine from the disc, makes room in the CPU, and loads the routine. Because MIDAS contains two different computers, Supernova's disc operating system (DOS) had to be modified in order to efficiently communicate with the DDP-516. The resulting executive is the integrated disc operating system (IDOS).

The control software for the online, or executable, phase is a real-time monitor. The monitor's function is also controlled by IDOS because the display controller is treated as real-time peripheral. The IDOS keeps track of programs and peripherals that are, or can be, activated to satisfy the simulation requirements while the program is running.

Display Software

The display software instructs the deflection and video processors (in the proper sequence) to produce a particular display format. This software is written as ALGOL-callable routines so that the programmer need only specify parameter values for the electron beam to sweep out as desired. Examples of the effects of this software are illustrated in figures 5, 6, and 7, which show, respectively, basic PPI, B-Scan, and waterfall formats. Each of these formats could be annotated to label cursor location and identification and to provide supplemental information (e.g., the two slanted lines in figure 6 are cursors). The waterfall test format shown in figure 7 is generated in the same manner as the DIMUS type format.

Interaction Software

Most interaction inputs produce interrupts that divert the system controller to a special memory location(s). The interaction software is necessary to ascertain the display channel and the peripheral from which the interrupt originated. The interrupt must also be interpreted and, possibly, executed.

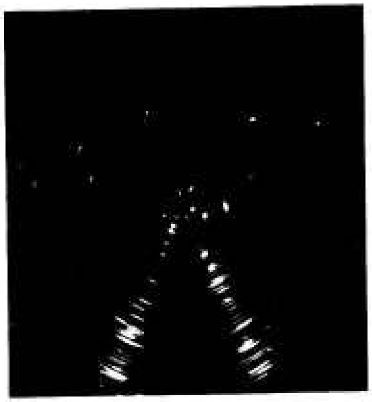

Figure 5. PPI Format

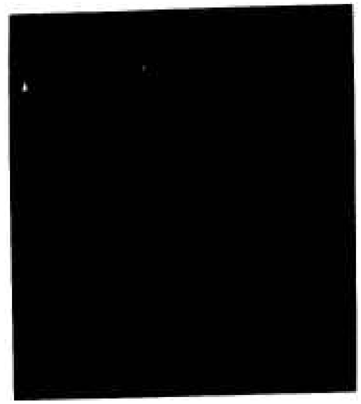

Figure 6. B-Scan Format

Figure 7. Waterfall Format

Since interrupts may originate from several sources, a priority system is required. For certain experiments, particular peripherals may have higher interrupt priorities than others. Hardware priority interrupt structure can accommodate some of them, but software is required to deal with cases in which many interrupts are received before they are executed and, thus, become stacked. The next processed interrupt could be the first-in/last-out, the first-in/first-out, or the highest priority.

The experimenter may monitor and measure the subject's performance via the interrupt control. Each response of the subject can then be recorded for time and accuracy.

Software for Models of Sonar Environment

A very important system feature is the software that implements the sonar model. Mathematical models of sonar targets, environment, own-ship noise, and sonar processor effects were developed for the AN/SQS-26 team trainer by Honeywell, Inc.[4,5] These completely digital and programmable models realistically simulate operational, i.e., at-sea, data at the display level. Minor changes to the models developed for the trainer were necessary for the AN/SQS-26 MOD studies and they were generalized to permit easy access to all tabularized data. The total set of mathematical models provides an extremely flexible and controllable data base for simulating sonar displays that is impossible to achieve using real data recorded at sea.

The total mathematical model set is partitioned into environmental, target, and sonar system subsets, each consisting of several modules. In each subset there are real- and nonreal-time parameters that may or may not be modified during an experiment. For example, the number of targets in the water is an allowable real-time change, whereas the own-ship processor gain curve is a fixed experimental parameter.

Environmental modules calculate the displayable effects of propagation paths, velocity profiles, ambient noise, bottom characteristics, and reverberation. Velocity profiles and reverberations are fixed parameters for a given experiment, although they can be modified offline. Online flexibility is demonstrated in table 1, where the number of discrete parameter values for each mathematical model parameter is listed.

Table 1. Environmental Real-Time Variables

Number of Discrete Parameter Values	Mathematical Model Parameters
6	Sea states
6	Layer depths
11	Bottom depths
4	Bottom types
3	Bottom slopes
10	Passive receiver sensitivity increments

Target modules require much processing effort because each target has its own module for (1) equations of motion, (2) radiated noise, (3) target strength, and (4) echo characteristics. The equation of motion module determines where on the display the target will be located; the strongest signal from among the other three modules is the resultant target data value that actually appears. Table 2 lists the types of targets currently modeled.

Table 2. Target Model Types

Deceptive Targets	Real Targets
Torpedoes Whale Porpoise Shrimp Pinnacle Kelp Ice	Submarine, nuclear Submarine, diesel Carrier Destroyer

Any number of real targets plus any four deceptive targets may be processed in real time for most operational displays. When introducing targets during the experiment, the experimenter inserts the appropriate dynamic characteristics (e.g., X-Y coordinates, depth, speed, rate of dive or climb, course, course change, etc.). These instructions are inserted via the function keys and keyboard on the research console.

Sonar system modules reflect the total AN/SQS-26 MOD design, which will be described in a subsequent report. Although the AN/SQS-26 MOD sonar system will incorporate all active sonar operating modes plus extensive passive processing, only the variable depression mode and the surface duct PPI will be discussed here.

The variable depression mode of the AN/SQS-26 MOD contains several features that are modeled and operational. Any two of four sonar data formats are available for instant call-up from the sonar console. The formats are search, expanded search (about the cursor location), classify/track, and target structure. In addition, a situation summary format that presents the tactical situation (supplemented by Naval Tactical Data System (NTDS) symbols) is also available at all times.

The AN/SQS-26 MOD PPI format (figure 8*) is entirely under digital control and, therefore, is developed differently than current operational systems that require long persistence CRT phosphors. The PPI is refreshed (i.e., the total sonar return data are retained on the display via repetitive refreshes) until the current ping sequentially overwrites the retained ping at the rate of a PPI scan.

Another MIDAS feature is the technique for communicating via the numerous function keys. Twelve keys are mounted vertically on each side of each CRT monitor. Each key is back-lighted, and physically as close to the CRT as possible. When the back-light is on, the key is enabled and the sonar modules must then write legends on the CRT adjacent to the appropriate function key (see figure 9).

MIDAS can be altered to simulate any other system by reconfiguring the sonar display console and modifying the software as necessary.

*Classified information has been d leted from this figure.

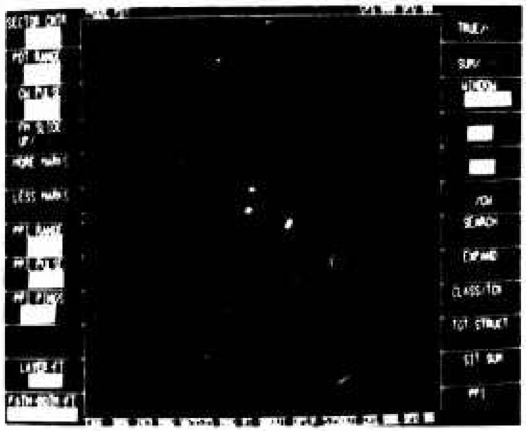

Figure 8. AN/SQS-26 MOD PPI Format

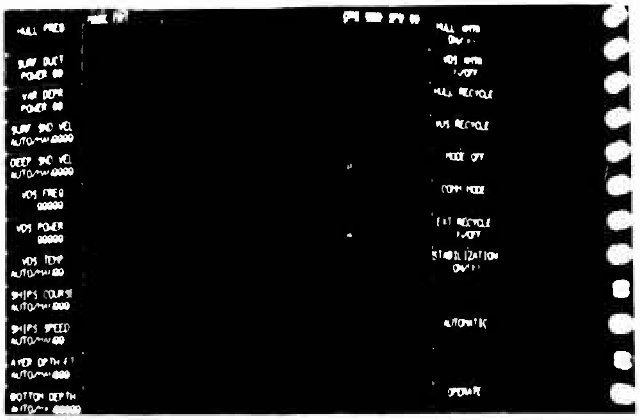

Figure 9. Back-Lighted Switches in Operation

Recorded Sea Data Feature

In addition to the elaborate software required to generate a data base for display simulation, the capability to read in and display real-time prerecorded at-sea data is provided. The data can be read and formatted by the Supernova for display in any of the AN/SQS-26 MOD formats.

Analytic Software

Much analytic software exists in the mathematical and statistical libraries resident in the large computing facilities. All of these routines are available to the experimenter. To analyze experiment results, he may record the data on magnetic tape, transfer the tape to the Univac 1108 computer facility at NUSC, and execute the 1108 library programs.

Since analytical software was not delivered with the basic system, it will be developed by NUSC. (See the section headed "System Expansion.")

TYPICAL OPERATION

System capabilities and component relationships may become clearer by describing a typical operation including the software initialization, experiment, and analysis phases. The description will also demonstrate the system's flexibility for a typical operation.

SOFTWARE DEVELOPMENT

Whether one is writing application or systems programs, the programs must enter the Supernova. This task is accomplished via teletype, paper-tape reader, card reader, or magnetic-tape drive. Once in, the program can be edited, debugged, and executed because these system routines reside on the disc. If the program must be removed for storage or external processing, it can be transferred to magnetic or paper tape.

INITIALIZATION

Initialization occurs offline, i.e., during nonreal time. The real-time mathematical models generate the data base from a series of tables and equations. The tabular data and equation coefficients must be calculated offline by initialization mathematical models. At this point, the experimenter selects the environment and other experimental conditions (e.g., targets and own-ship characteristics). He then loads into the DDP-516 the offline mathematical models and the initial conditions from paper tape, magnetic tape, cards, or disc. After compilation, the mathematical model tables and equations are properly loaded into the DDP-516.

Actual sea data recorded on magnetic tape could be used as the data base in lieu of the mathematical models. In such a case the Supernova would read the data in for display from the magnetic-tape unit instead of from the DDP-516.

Someone, most likely the experimenter, must prepare a program to define the operation of all the required peripherals, the display routines and their required parameters, and, if necessary, the real-time analyzing routines. This main program defines the experiment. Since the display format routines are ALGOL-callable, the main program may be written in ALGOL. It is recognized that all display researchers may not be computer programmers, so this high-level language feature is provided.

At this point all pertinent equipment is energized and all callable routines are accessible in the computer core or disc; MIDAS is ready for the experiment.

EXPERIMENT

The experimenter shows the subject how to use the display console and describes operational tasks (e.g., search and detect, track, classify, or any combination of these). The subject is then left to observe the CRTs and use the interaction tools as appropriate.

Since both display channels are typically in full operation, the experimenter monitors the operation at the DDP-516 teletype. Should he wish to modify the program to introduce a new target, different target dynamics, new bottom depth, or different weather conditions, etc., he may do so via the extensive set of function keys located on the research console.

The subject can select any two formats for display within a given operating mode. He may select both the PPI format (see figure 8*) for close-in coverage and the variable depression search format (see figure 10) for extended-range coverage while other formats, although resident on the disc, are updating their histories. He also operates the console as in the real world; i.e., he may change range scales, ping characteristics, cursor positions, marking densities, etc.

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*See the footnote on page 15.

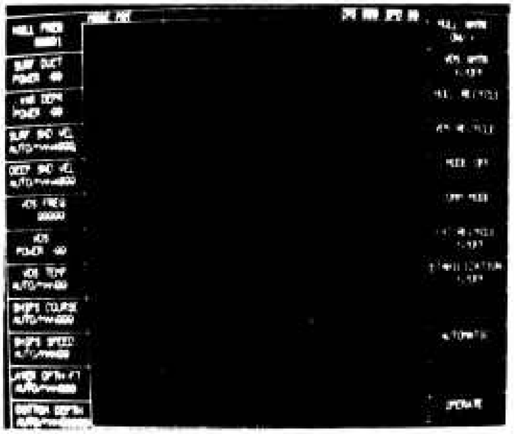

Figure 10. AN/SQS-26 MOD Variable
Depression Search Format

The subject is required to communicate to the experimenter all he knows about the targets presented. The experiment will be terminated on the basis of the subject's performance or elapsed time and the experimenter can then analyze the data.

SYSTEM EXPANSION

The flexibility of the system and the capability of the hardware to perform in the many ways the software requires have been demonstrated in the above discussion. Another flexible aspect of the MIDAS hardware is its expansion possibilities.

RESEARCH MONITOR

One of the next additions to MIDAS will be a large (greater than 21-in.-diameter) CRT monitor with the smallest spot size and tightest deflection control technically possible. The total system was designed for this high-resolution large-tube monitor. Such a powerful display device will provide the capability to experiment on all currently proposed formats.

OFFLINE SOFTWARE DEVELOPMENT

Because of the many individual experiments and projects scheduled for MIDAS, efficient software development is seriously jeopardized. MIDAS is usually operated for 19 hours each day without time being reserved for maintenance or repair. The 7 users are normally permitted only 1.5 hours each per day because 8 hours are required for the contractor to continue the software development. Also, whenever an experiment is conducted or maintenance performed, software development progress is severely degraded.

An offline software development complex is being designed to help solve these problems. The complex will be centered around a Data General Minicomputer and Disc so that software compatibility with MIDAS can be preserved. Approximately 4 operator terminals will permit simultaneous program entry, editing, compiling, assembling, and debugging. Such a software complex would permit executable routines to be developed whether MIDAS is being operated or not.

COMPUTERS

The Supernova computer was configured for maximum memory. However, Data General has developed and made available a semiconductor memory that increases the Supernova's internal speed by 25 percent (from 800- to 600-ns cycle time). This new memory is plug-in compatible with the existing core memory. Also, new Data General computers released since the MIDAS design was frozen have compatible software instruction sets.

The DDP-516 is also configured in maximum core memory. It is currently used as a special purpose peripheral, whereas, in the future, it could be an elaborate, intelligent peripheral preprocessor for interfacing MIDAS with other computer systems.

PERIPHERALS

Since MIDAS is a system for exploring the man-machine information transfer functions, all possible interaction devices must eventually interface with it. This concept has been carried through from the earliest days of system design. Examples of interaction devices to be added are an eye tracker and a data tablet.

ANALYTIC SOFTWARE

As mentioned earlier the experimenter must currently analyze his data offline; i.e., he must collect the data and have them processed on the NUSC Univac 1108 computer because no analytic software currently exists. An extensive effort will be directed to analytic software resident on the MIDAS Supernova and DDP-516 computers, or both. Although offline data reduction is valuable, online instant analysis capabilities are highly desirable in display research. It permits the experimenter to monitor the real-time progress of the experiment and effect changes as required. This real-time software effort can be as simple as generating a histogram or maintaining an average, but it can also provide a complex statistical analysis. The variety and sophistication of analytic software in real time are functions of the required result and the amount of time necessary to perform the calculation.

LIST OF REFERENCES

1. J. C. Lamb, A. C. Krajec, and W. A. Clearwaters, "Application of Minicomputers in Display Simulation," Electronics, vol. 46, no. 10, 10 May 1973 (UNCLASSIFIED).

2. D. K. Hadley, R. E. Corby, J. C. Freeborn, J. T. Shioski, and J. R. Smith, AN/SQS-26 MOD Sonar Program Display Subsystem Simulator Hardware Documentation, Volume I, Honeywell Technical Document 604-72, 6 October 1972 (UNCLASSIFIED).

3. R. F. Halley, R. N. Kuruma, D. L. Bradley, G. W. Staley, G. W. Moore, and J. R. Smith, AN/SQS-26 MOD Sonar Program Display Subsystem Simulator General Software Documentation, Honeywell Technical Document 015-73, 31 January 1973 (UNCLASSIFIED).

4. D. M. Almos, G. S. Kinoshita, and R. N. Kuruma, Program Report for Basic Operator/Team Trainer for the AN/SQS-26CX Sonar Device 14E19 (U), Honeywell Technical Document 426-71, January 1972 (CONFIDENTIAL).

5. I. S. Frost, M. F. Strum, and D. T. Rowe, AN/SQS-26 MOD Sonar Program Display Subsystem Simulator Math Model Final Report (U), Honeywell Technical Document 597-72, 15 August 1972 (CONFIDENTIAL).

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13. ABSTRACT

The Machine for Information Display and Simulation (MIDAS) is a tool for basic display research and a simulator for evaluating console design. A Data General Supernova Minicomputer directs the operation of two independent high-resolution display controllers. A Honeywell DDP-516 Minicomputer executes real-time mathematical models of the AN/SQS-26 sonar system and its environment and targets. Control of the wide dynamic range of display parameters (e.g., refresh rate and video and deflection signals) are accessible to the experimenter for display research. The simulation capabilities of MIDAS are demonstrated by its display-level simulation of the AN/SQS-26 MOD Display Subsystem in order to evaluate the subsystem prior to specification. The MIDAS hardware is described with emphasis on that which is special purpose as opposed to commercially available equipment. The discussion of software also emphasizes the special purpose category, which consists of control, display, interaction, modeling, and analytical efforts. A typical sequence for initiating an experiment is described, and current plans and accommodations to expand MIDAS are discussed.

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Computer Driven Displays						
Diagnostic Panel						
Display Controller						
Dual Independent Display Channels						
High-Resolution Deflection Processors						
High-Resolution Displays						
Interaction Devices						
Interactive Displays						
MIDAS Expansion						
MIDAS Operation						
Video Processor						